King Edward VI Camp Hill School for Girls

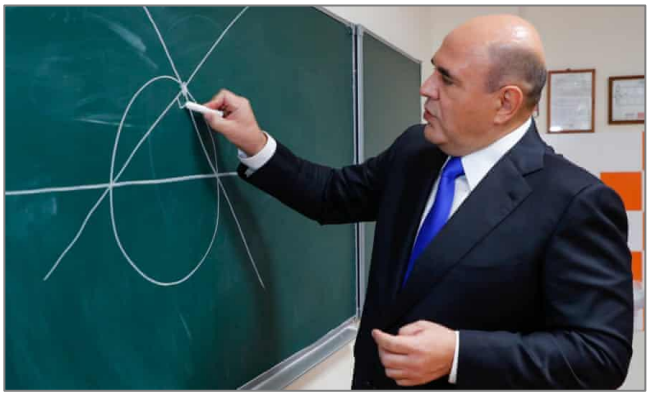
Maths Department Newsletter

18th October 2021

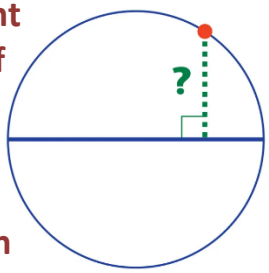
91 is not a prime number

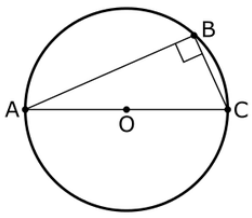
News

An interesting story appeared in the news recently. Russia's Prime Minister[1], Mikhail Mishustin, visited a sixth form class in one of their top schools and drew a geometry problem on the board.



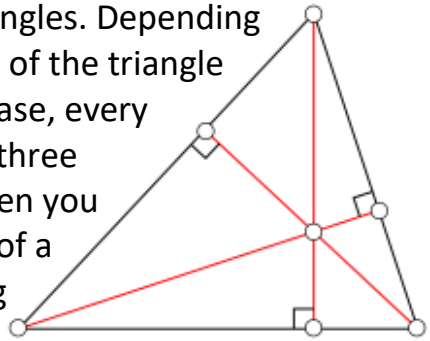
The problem can be stated in the following way: **For any given point on the circumference of a circle, how can you construct a vertical line, through the point, perpendicular to a given diameter?** Remember, this is geometry, so the only things you are allowed to use are a pencil, a straight edge[2], and a pair of compasses. There are a few different ways to solve this problem, but one particularly neat method involves Thales' Theorem, which says that if you join the two ends of a diameter (AC in the diagram) to a point (B) on the circle, the angle where the lines AB and BC meet with be a right angle. You can read a full solution of this maths puzzle by following the link in the footnotes.[3]





Maths Words

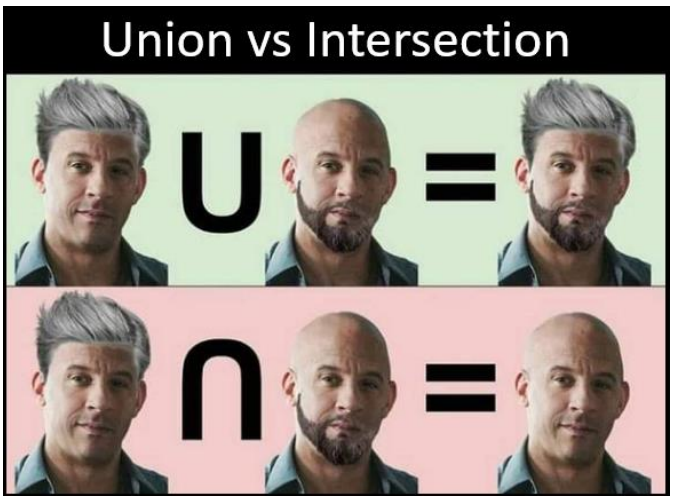
An **altitude** of a triangle is a straight line joining one of its corners to the opposite side at right angles. Depending on which side of the triangle you call the base, every triangle has three altitudes. When you find the area of a triangle, using the formula



Area = ½ × base × perpendicular height, the perpendicular height is the altitude. Triangles are very surprising shapes. One surprising thing about them is that if you draw in all three altitudes, you will find that they all pass through the same point. This point is called the **orthocentre** of the triangle. A triangle has several different centres. Can you find out what they are all called and what the Euler line is?

Joke

Meanwhile, here's a meme about set notation. I think the punchline is probably 'Venn Diesel', or something like that.



1. I didn't even know Russia had a Prime Minister!
2. Not a ruler, with which you can measure. Just something to draw a straight line with.
3. This one: https://www.theguardian.com/science/2021/sep/20/did-you-solve-it-russias-prime-minister-sets-a-geometry-puzzle

Why is 91 not prime?

Well, the short answer to why 91 isn't prime is because it's 13 × 7, so it's a semi-prime.[4] The more interesting question is 'why is it interesting that 91 isn't prime?' The answer to this has to do with the question 'if I think of a number between 4 and 100, how can I tell if it's prime or not?' – for example if I thought of, say, the number 71. Is that prime? Here's a method you might like.[5] The first thing is to notice that all primes greater than 3 are one away from a multiple of 6.[6] Look at all the numbers between 1 and 100 that are next to a multiple of 6.

5	**6**	7	11	**12**	13	17	**18**	19
23	**24**	25	29	**30**	31	35	**36**	37
41	**42**	43	47	**48**	49	53	**54**	55
59	**60**	61	65	**66**	67	71	**72**	73
77	**78**	79	83	**84**	85	89	**90**	91
95	**96**	97						

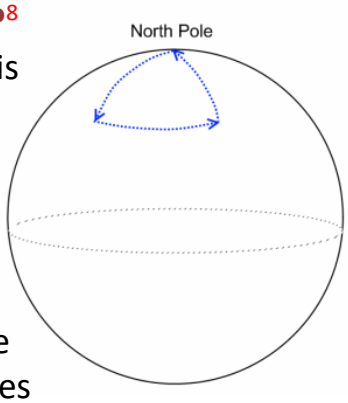
If we cross out all the ones that are obviously not prime (25, 35, 49, 55, 65, 77, 85 and 95) we are left with this list:

5	**6**	7	11	**12**	13	17	**18**	19
23	**24**	~~25~~	29	**30**	31	~~35~~	**36**	37
41	**42**	43	47	**48**	~~49~~	53	**54**	~~55~~
59	**60**	61	~~65~~	**66**	67	71	**72**	73
~~77~~	**78**	79	83	**84**	~~85~~	89	**90**	91
~~95~~	**96**	97						

The only non-crossed-out non-green non-prime number is 91. All the rest are prime. This means that one way to tell if a number between 4 and 100 is prime is to check if it's next to a multiple of 6. If it isn't, it's not prime. If it is, and it's not obviously not prime, then check if it's 91. If it's not 91, then it's prime.

Famous Puzzle

As you know, the angles in a triangle always add up to 180°. The only problem with that fact is that they don't – well, they do, but only if you are working on a flat surface.[7] What about if you draw your triangle on the surface of a sphere, for example? There is a very famous puzzle that goes like this: **A polar bear walks one mile south, then one mile west, then one mile north, and ends up exactly where he started. Where could he have been when he started walking?**[8]



One answer to this is that he could have been at the North Pole. Think about it. You go one mile south, then turn 90 degrees, walk a mile west, turn 90 degrees then walk a mile north. You will have walked in a triangle whose angles add up to 270°. This is what happens when you draw triangles on a curved surface. There is, however, a more interesting answer to the puzzle. There are many other places the bear could have started walking from, apart from at the North Pole. Can you work out where they are?

Lunchtime Clubs

Don't forget, in the maths department there is Chess Club on Monday lunchtime (room 14), Key Stage 4 and 5 Maths Society on Thursdays week A (room 15), Maths Workshop on Thursday (room 13) and Code Breaking Club on Fridays (room 13). Let us know if you if find any interesting maths things for the next newsletter! 😊

4. Have you heard of semi-primes? They're the numbers that are the product of two primes.
5. You might not. That's fine too.
6. That's not the same as saying every number next to a multiple of 6 is prime. That's clearly false.
7. Fortunately for you, GCSE Maths papers are always flat surfaces.
8. Apparently, Elon Musk has been known to use this question when he interviews people.